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C-A OPERATIONS PROCEDURES MANUAL

15.5.70 Coating of Vacuum Chamber using Magnetron Sputtering

Text pages 2 through 4

Hand Processed Changes

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Approved: _____ *Signature on File* _____
Collider-Accelerator Department Chairman Date

R. Todd

1. Purpose:

- 1.1 The purpose of this procedure is to clearly identify the steps necessary to safely operate the equipment use when coating chambers using magnetron sputtering.

2. Responsibilities:

- 2.1 This procedure is to be followed by qualified Vacuum Group personnel.
- 2.2 Qualified personnel shall possess Electrical Safety I Training. Appropriate CAD Electrical Safety Training, LOTO - Authorized training.
- 2.3 Qualified personnel shall closely adhere to this procedure to ensure safety to personnel and equipment.
- 2.4 A log book (clearly marked three-ring binder) shall be maintained by the Cognizant Engineer which shall include completed Attachment 1 forms, and any relevant witness coupons and RGA scans.

3. Prerequisites

- 3.1 All protective cathode covers shall be in place prior to energizing power supply.
- 3.2 A lockable boot (LOTO by the Cognizant Engineer) shall be installed on the power supply power cord when not in use. This boot shall be removed only by the Cognizant Engineer when the output cable is securely fastened to the cathode and the Lexan covers are installed.
- 3.3 Prior to coating, the chamber, magnetron power supply, additional equipment and equipment rack shall be grounded to suitable earth ground.
- 3.4 The Lexan cathode covers must be secured in place prior to energizing of the magnetron power supply.
- 3.5 All personnel working on any electrical system or equipment in the C-AD shall be familiar with BNL [SBMS Electrical Safety](#), BNL [SBMS Lockout/Tagout \(LO/TO\)](#), [C-A-OPM 1.5, "Electrical Safety Implementation Plan"](#), [C-A-OPM 1.5.3 "Procedure to Open or Close Breakers and Switches and Connecting/Disconnecting Plugs"](#), [C-A-OPM 2.36, "Lockout/Tagout for Control of Hazardous Energy"](#). C-AD will provide on-site/work specific training to individuals in the electrical safety aspects of their job functions, appropriate PPE, and assignments.
- 3.6 UV rated polycarbonate safety glasses with side shields, meeting requirements of ANSI Z87.1-1987 shall be worn when observing the discharge.
- 3.7 While work is underway and an abnormal condition arises, re-review the job against criteria in applicable SBMS Subject Areas, and/or work planning requirements. If unsure of further actions, discuss situation with supervisor.

4. **Precautions:**

The sputtering power supply used in the procedure can produce lethal operating voltages. Failure to read, understand and follow this procedure may cause serious injury or death.

5. **Procedures**

5.1 **Chamber Installation**

Note:

A procedure checklist shall be completed for each chamber (Attachment]). This checklist shall be maintained by the Cognizant Engineer as each step is completed.

- 5.1.1 Check with the Cognizant Engineer for the correct configuration of hardware for the chamber to be coated. (i.e. Cathode and magnet type, RGA type(s) and location(s), witness coupon type(s) and location(s), turbopump location(s), mass flow controller(s) etc.)

Note:

White gloves shall be used when handling any internal components of the system. This includes, but is not limited to the cathode, coupons, and nitrogen tubes.

- 5.1.2 With the correct configuration established, pump down the chamber and leak check the entire system to a sensitivity of 1×10^{-10} atmcc/sec helium.

5.2 **Chamber Bakeout**

- 5.2.1 Prepare the chamber for bakeout using either heating tapes and/or heating jackets.

Note:

If the chamber is to be controlled with Variacs, then care must be taken to closely monitor the ramp rate and equilibrium temperature.

- 5.2.2 Unless otherwise specified, the temperature of the bakeout shall be 200 deg C.

5.3 **Chamber Coating:**

- 5.3.1 After 24 hrs. at temperature, record the chamber pressure. A pressure greater than 5×10^{-6} Torr shall be investigated using a leak detector. When possible, take an RGA scan of the system to look for leaks and/or unwanted contamination. A copy of the RGA scan shall be maintained in the log book.
- 5.3.2 Install the proper magnet strings.
- 5.3.3 Install the rubber coupling on the other end of the cathode and begin cathode coolant circulation. The water level in the reservoir will drop and may need to be topped off with coolant. Be sure that all air bubbles have been removed from system. Observe for any leaks of coolant.

5.3.4 Route the power lead from the power supply through the hole in the Lexan cover and secure to the cathode with a hose clamp. Secure the shielded ground of the cable to the attachment point of the spool assembly using a hose clamp.

5.3.5 Install Lexan shield cathode covers and securely fasten all retaining screws.

Note:

Contact the Cognizant Engineer prior to the initiation of discharge. The Cognizant Engineer will establish the discharge and equilibrium flow rates necessary for each and every chamber.

5.3.6 With verification of all system grounds, correct output cable termination and protective cover installation as per attachment 1 sign off sheet. Remove the (LOTO) boot on power supply and plug into suitable outlet in accordance with [C-A-OPM 1.5.3](#).

Note:

Due to the heat introduced by the discharge, power to the heating jackets may need to be reduced to maintain the bakeout temperature. Adjustments should be made accordingly.

CAUTION:

The equipment cannot be left unattended while the power supply is energized.

5.3.7 When sputtering is completed, the power supply shall be unplugged in accordance with [C-A-OPM 1.5.3](#), locked out (LOTO), in accordance with [C-A-OPM 2.36](#), with a boot on the power receptacle and the gas flow stopped. Close the MFC valves and the gas bottle valves. Turn off heater and allow coolant to circulate until the chamber is cool.

5.4 Chamber Removal

5.4.1 When the system is cool remove the chamber by reversing the steps outlined. Remove the coupons and mark their location appropriately. These coupons shall be stored in a protective slide holder.

5.4.2 Blow the chamber clean with compressed dry nitrogen to ensure any particulates are removed.

5.4.3 The Cognizant Engineer shall put the completed procedure sign-off sheet for each chamber, associated paperwork and the witness coupons in the log book. This documentation shall reside with the Cognizant Engineer.

6. Documentation

None

7. References

- 7.1 [C-A-OPM 1.5, “Electrical Safety Implementation Plan”.](#)
- 7.2 [C-A-OPM 1.5.3 “Procedure to Open or Close Breakers and Switches and Connecting/Disconnecting Plugs”.](#)
- 7.3 [C-A-OPM 2.36, “Lockout/Tagout for Control of Hazardous Energy”.](#)
- 7.4 [SBMS Electrical Safety.](#)
- 7.5 [SBMS Lockout/Tagout \(LOTO\).](#)

8. Attachments

- 8.1 Procedure Checklist (Critical Items Only).

ATTACHMENT 8.1 - PROCEDURE CHECKLIST (CRITICAL ITEMS ONLY) REV.A

CHAMBER INFORMATION

* SEE BACK FOR SPECIAL NOTES*

Date: _____

Chamber Type: _____

Drawing No. _____

Chamber Serial No.: _____

CHAMBER PREPARATION

DATE

INITIAL

Check for cleanliness and blow out chamber with dry nitrogen

Install chamber using proper configuration

Install proper witness coupons

Leak check

RGA scan

Bake start time: _____

RGA scan

Chamber pressure Torr: _____

CHAMBER SPUTTERING

Verify all system grounds.

chamber

power supply

equip. rack

Install magnets

Initiate and verify proper cathode coolant flow

Securely terminate power supply output to cathode

Install cathode protective covers and secure

System is ready for sputtering

Remove LOTO boot from power supply and plug into power receptacle

Sputter start time: _____

Gas flow rate(s) (sccm) GAS: _____

GAS: _____

Discharge voltage

Discharge current (amps)

Sputter end time: _____

Elapsed time of deposition minutes: _____

De-energize power supply and install boot on power cord

terminate bakeout